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ERM

29 June 2000
Reference: 30710.00.01
VIA FACSIMILE AND OVERNIGHT DELIVERY

Ms. Jill Lowe
Remedial Project Manager
U.S. Environmental Protection Agency
1650 Arch Street
Philadelphia, PA 19103-2029

Re: Dublin NPL Site Feasibility Study (FS)

Dear Jill:

The purpose of this letter is to provide responses to EPA's 23 May 2000 comment letter and to summarize key discussions from the 30 May 2000 meeting regarding the revised draft FS. The responses provided herein are a follow-up to the discussions of our meeting on 30 May 2000. Consistent with the agreement reached during the 30 May meeting, revisions to the document are indicated in strikethrough/underline format and only those pages of the document subject to modification are being provided with this correspondence (see Attachment 1). Upon approval of the proposed changes, Sequa will produce complete copies of the revised FS for distribution. EPA's comments from the 23 May 2000 correspondence are repeated below followed by Sequa's response.

1. **Comment**: *The comparison of alternatives in the Revised Draft FS Report to the nine evaluation criteria set forth at 40 C.F.R. Section 300.430 (e)(9)(iii) of the National Oil and Hazardous Substances Contingency Plan is heavily based toward selection of only certain alternatives and does not allow for an objective evaluation of all alternatives. Some examples follow:*

   Response: Sequa recognizes EPA's concerns regarding the perception of a bias in the evaluation of alternatives, and has made a concerted effort to address the Agency's concerns in the revisions to the document that are provided in Attachment 1 to this letter. As Sequa discussed during the 30 May meeting, Sequa revisited the Comparative Analysis of Alternatives (Section 5 of the FS), and especially the summary evaluations presented in Table 7. As an example, Sequa believes its objectivity is evidenced by the favorable summary ratings received by Alternatives 4C and 8. Accordingly, Sequa expressed its opinion that it did not find support for the characterization that the evaluation was heaviliy biased.

a. *The disclaimer that appears numerous times in the Revised Draft FS Report, which notes that the most aggressive alternatives were not developed in accordance with USEPA guidance, but rather were added to the detailed evaluation of alternatives at the direction of USEPA, creates a bias for evaluation of these alternatives. EPA contends that these alternatives would have remained in an unbiased evaluation of alternatives.*

Response to Comment 1a: As agreed on May 30th, Sequa will delete the referenced statement (see revised pgs. ES-3, 2, 8, 42, 65, and 76).

b. The editorial statement in sections 4.6.2.7 and 4.6.3.7 that relate cost with implementability concluding that the alternatives are not implementable at any cost.

Response to Comment 1b: The footnote that appears on pgs. 72 and 75 related to the Net Present Value cost estimate for Alternatives 7 and 8 has been revised, along with the estimated costs for those alternatives (see revised pgs. 72 and 75, as well as the detailed cost tables C-1, C-8 and C-9).

As suggested by EPA during the 30 May meeting, ERM evaluated the feasibility of discharging the treated effluent in Alternatives 4C, 7 and 8 to the Dublin Borough municipal storm sewer system rather than constructing an effluent pipeline to convey the effluent to Morris Run. Communications with Dublin Borough, along with evaluations of storm sewer system design information provided by the Borough, resulted in the conclusion that such a discharge would be feasible and, therefore, would represent a technically superior and more cost-effective option for discharging the effluent than the pipeline to Morris Run. Text in Section 4.4, 4.6.1.5 and 4.6.2.5 has been revised to reflect the change in design. Also, the summary evaluation of Alternatives 4C, 7 and 8 in Table 7 relative to the "Short term Effectiveness" criterion has been revised to reflect the improved design of the effluent discharge for these three alternatives (in conjunction with the acknowledgement that a breach in the ground water collection and conveyance system is a low probability event - see response to Comment 1c).

c. *The Short-Term Effectiveness discussion for Alternatives 4C, 7 and 8 discusses risks which have a low probability of occurring. For example, rupturing of the pipeline which is transporting the contaminated water to the treatment facility. Alternative 5 would require a similar transport of contaminated water from the downgradient well (Whistelwood) to the OU1 treatment facility, but the risk of rupture is not mentioned in the discussion of Short-Term Effectiveness.*

Response to Comment 1c: Sequa acknowledges EPA's comment regarding the low probability of a pipeline rupture. However, Sequa's intent in identifying the possibility of a breach in the pipeline was to compare the potential risks associated with transporting water having different contaminant concentrations. There is a significant difference between Alternative 5 and Alternatives 4C, 7, and 8 in terms of expected concentrations. The expected concentrations of TCE from the DGW (Alt. #5) would be in the range of 300-400 ppb. Whereas, portions of the collection and manifold system for Alternatives 4C, 7 and 8 would be conveying ground water with TCE concentrations of approximately 10 ppm. In response to EPA's comment, the wording in Sections 4.6.1.5, 4.6.2.5, and 4.6.3.5 has been revised to reflect the low probability of a breach in the ground water collection and conveyance systems for Alternatives 4C, 7 and 8, but also to reflect the potentially more serious consequences if such a release were to occur. Revisions have also been made in Table 7 to reflect the low probability of a breach in the ground water collection and conveyance systems of Alternatives 4C, 7 and 8. In effect, in the summary evaluation (i.e., Section 5) the "higher consequence" associated with the potential breach of the collection and conveyance pipelines that are part of Alternatives 4C, 7 and 8 is no longer a significant factor (see revised Table 7).

d. *The implication that a treatment system could not be designed to effectively treat groundwater to meet NPDES permit limits is not justified. Surface water discharge of treated groundwater is an acceptable practice.*

Response to Comment 1d: Sequa agrees that discharging to surface water is an acceptable practice. However, as discussed and agreed at the 30 May meeting, it is generally considered more favorable to discharge to a POTW (indirect discharge) rather than directly to surface water (direct discharge), primarily because of the additional treatment afforded by the POTW. Please note that discharge to the municipal storm sewer, as is now contemplated for Alternatives 4C, 7 and 8 (see response to Comment 1b), is considered a direct discharge. Sequa reviewed the FS for any reference or implication that discharge to surface water could not be effectively designed. Although Sequa was unable to identify any such references, Sequa will modify the document should any such references be identified. Additionally in response to EPA's comment, Sequa has reconsidered the summary evaluation of those alternatives involving a direct discharge (i.e., Alternatives 4C, 7 and 8) with respect to the detailed evaluation criterion of "compliance with ARARs". Although an indirect discharge is viewed as being more favorable than a direct discharge, Sequa has revised the summary evaluation (see Table 7) to indicate that both the indirect and direct discharges would be "acceptable" with respect to the "compliance with ARAR's" criterion.

e. *The assumption that access cannot be secured, therefore, the property would need to be purchased unjustly biases the cost of Alternatives 7 and 8.*

Response to Comment 1e: In order to perform a complete and balanced evaluation of all alternatives, it was necessary for Sequa to consider the feasibility and cost associated with securing access to private property to implement those alternatives that involve off-site pumping (ref. EPA's guidance entitled *Remedial Action Costing Procedures Manual*, EPA, 1987). Sequa's analysis of securing property access is based on prior site specific experience in Dublin Borough. Sequa has entered into numerous access agreements involving varying degrees of work, acquired property associated with the OU-1 work, and hired appraisers to visit and meet with various owners for potential new well sites. Based on this experience, and for the purpose of providing a comparative analysis, Sequa developed estimated costs for securing the necessary property access. Sequa acknowledges that predicting the feasibility and costs for securing access to private property is difficult.

In an effort to respond to EPA's concern, Sequa revisited the cost estimates presented in the FS. The conclusion reached by Sequa is that, in all likelihood, the costs necessary to secure access will vary widely depending upon the property owner, and conceivably could range from $0 to the full market value of the property. Therefore, for comparative purposes, Sequa has assumed a value of one-half the market value as an average cost for securing all of the necessary property access. The estimated values for residential and commercial properties were obtained via telephone interviews with real estate agencies in Dublin

Borough. The number of residential versus commercial properties was established based on a conceptual design intended to minimize the number of properties for which access would be needed and the total length of the conveyance pipeline. These materials (i.e., telephone logs and conceptual designs) are available for review if desired.

2. **Comment**: *The Revised Draft FS Report includes various unsubstantiated statements regarding the inability to remediate the groundwater to MCLs. Such statements do not belong in a FS Report. If there is enough data to substantiate this claim, it should be done in a Technical Impracticability Waiver Request.*

Response to Comment 2: Sequa acknowledges that there is not sufficient empirical site data upon which to make a technical impracticability determination with respect to the remediation of ground water to MCLs. The statements in the FS are based on the extent of remediation predicted by the ground water fate and transport model. Sequa included this analysis in accordance with EPA guidance (specifically referenced are EPA's RI/FS guidance (EPA, 1988) and EPA's guidance entitled *Modeling Remedial Actions at Uncontrolled Hazardous Waste Sites* (EPA, 1985)). In response to EPA's comment, Sequa revisited the FS to assure that any reference to future remediation accurately identifies the ground water model as the basis of the assertion that remediation to MCLs may not be achieved, and has clarified this statement in all locations within the FS identified by Sequa. If additional locations are identified by EPA, Sequa will modify that language as well.

3. **Comment:** *It is stated in several locations that the OU1 Waterline is fully protective of human health and the environment. EPA has always maintained that the waterline is not fully protective of human health and the environment in future conditions.*

Response to Comment 3: Sequa agrees that the implementation of OU-1 by itself is not protective of human health and the environment relative to future conditions. Based on the findings of the RI and the BLRA, the statement with respect to future conditions was intended to relate to the OU-1 water line in combination with institutional controls and a long term monitoring program. Sequa has reviewed the language of the FS to identify any text where it was stated or implied that the OU-1 remedy by itself was fully protective of human health and the environment, and has revised those pages accordingly. Again, if EPA identifies any additional locations where such statements or implications are made, Sequa will revise those pages as well.

4. **Comment:** *EPA's decision to complete the Feasibility Study will expedite the decision making process.*

   Response to Comment 4: At the 30 May meeting, EPA agreed to retract this comment and provide Sequa an opportunity to respond to EPA's comments and revise the FS.

Sequa is confident that the responses provided above along with the revisions made to the draft FS are acceptable to USEPA. We are presently in the process of responding to the additional comments provided in your letter of 15 June 2000, and may contact you by phone to discuss several of those comments. In the interim, and as always, please do not hesitate to call either Brent Murray at 561/624-5747 or me at 410/266-0006 with any questions or comments.

Sincerely,

Gary Walters

Gary L. Walters
Principal-in-Charge

GLW:dmb

Enclosure: Attachment 1

cc: M. Timcik, PADEP
B. Murray, Sequa
C. Boyle, Esq., DB&R
D. Collins, ERM

Attachment 1
Revised Pages of Draft FS
(in strikethrough/
underline format)

Modeling, however is not an exact science. Therefore, any reliance on modeling must consider its limitations. Nevertheless, despite its limitations, modeling remains a valuable tool for predicting future conditions[1]. A combination of a three dimensional ground water flow and solute (i.e., contaminant) transport model was used to predict potential future conditions under a number of potential remedial scenarios.

During the technology screening step of the FS process, a total of 27 remedial technologies and/or process options were screened for applicability to the Dublin Site. All technologies were screened for applicability to the Dublin Site based on effectiveness (in achieving the stated remedial action objectives), implementability, and relative cost.

Eleven technologies were retained as being applicable and were subsequently assembled into complete remedial alternatives.[2] Since it was determined in the BLRA that ground water was the only media of concern (i.e., the only media that posed unacceptable risks to human health and the environment), the majority of the technologies that were identified and screened applied to the general response actions of containment, recovery, and treatment (in-situ and ex-situ) of either contaminated ground water or "source material" (i.e., source of contaminated ground water, which is suspected to be non-aqueous phase liquid (NAPL) in the immediate vicinity of the 120 Mill Street property).

Nine remedial alternatives were assembled and subjected to a detailed evaluation in accordance with the procedures presented in the NCP and

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[1] Because this FS relies almost solely on modeling, the selection of a final remedy should also consider a number of other means of analysis. These methods of analysis were completed in the RI to evaluate future temporal trends.

[2] ~~Note that the most aggressive alternatives were not developed in accordance with USEPA guidance (ref. USEPA, 1988), but rather were added to the detailed evaluation of alternatives at the direction of USEPA. Accordingly, these alternatives consist of component technologies or process options that may not have survived the technology screening process of a conventional FS. At the least, when subjected to a detailed evaluation, significant issues are raised relative to several of the technology screening criteria (e.g., "implementability" and "cost"). Nevertheless, the level of detailed evaluation performed is sufficient for conducting a comparative analysis of these alternatives relative to other candidate alternatives. However, if these alternatives are considered beyond this FS, additional detailed analysis would be required to confirm their feasibility and implementability.~~

Contingency Plan (NCP, 40 CFR 300), thereby ensuring that the recommended remedy *is* the most appropriate final remedy for the Dublin NPL Site.[1]

1.2 *PROJECT OVERVIEW*

The Dublin NPL Site ("Site") is defined as the 120 Mill Street Property located in Dublin Borough, Bucks County, Pennsylvania, as well as all adjacent areas to which site-related contaminants have migrated (USEPA, 1995) (see Section 1.3 for extent of contamination). Investigative activities began at the Site in 1986 when the Bucks County Health Department (BCHD) initiated routine sampling of water supply wells in the Dublin area. Contamination, principally trichloroethene (TCE), was detected in 36 supply wells. In 1987, Mr. John Thompson, current owner of the 120 Mill Street property, entered into a Consent Order with the USEPA to provide and maintain treatment systems for all residential and commercial locations where TCE was found at levels in excess of the Maximum Contaminant Level (MCL, i.e., drinking water standard). The Thompson Consent Order also required Mr. Thompson to monitor the impacted supply wells at frequencies which varied from quarterly to semiannually, depending upon the concentration of TCE detected in the wells.

A search for potentially responsible parties (PRPs) conducted by USEPA in 1987 identified a number of prior and current owners of the 120 Mill Street property, including Mr. Thompson, Athlone Industries, Inc., and Kollsman Instrument Corporation (KIC). Sequa Corporation is the corporate successor of KIC.

In June 1990, Sequa entered into a Consent Order with the Pennsylvania Department of Environmental Resources (PADER, subsequently the

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[1] ~~Note that the most extreme alternatives were not developed in accordance with USEPA guidance (ref. USEPA, 1988), but rather were added to the detailed evaluation of alternatives at the direction of USEPA. Accordingly, these alternatives consist of component technologies or process options that may not have survived the technology screening process of a conventional FS. At the least, when subjected to a detailed evaluation, significant issues are raised relative to several of the technology screening criteria (e.g., "implementability" and "cost"). Nevertheless, the level of detailed evaluation performed is sufficient for evaluating the alternatives. If these alternatives are pursued, additional detailed analysis would be required to confirm their feasibility and implementability.~~

In accordance with the applicable requirements and guidance, this FS consists of a multi-phase screening process to identify and select the most appropriate remedial alternative for the Site to protect human health and the environment. The major steps associated with the identification and evaluation of remedial alternatives in this FS are as follows (EPA, 1988):

- establishment of remedial goals (i.e., remedial action objectives) based on the findings presented in the final RI and BLRA;
- identification and screening of a focused group of potentially viable remedial technologies and process options for remediation of impacted media at the Site;
- development of preliminary remedial alternatives for the Site by assembling the most promising technologies and/or process options[3];
- detailed evaluation of the remedial alternatives against the nine evaluation criteria mandated in the NCP and EPA guidance; and
- a relative comparison of the potential remedial alternatives based on the results of the detailed evaluation.

1.6 FS ORGANIZATION

The remainder of the FS report is organized as follows:

- Section 2.0, *Remedial Action Objectives* - identifies the media of concern and the remedial action objectives to be addressed;
- Section 3.0, *Identification and Screening of Technologies* - describes the identification and screening of potential remedial technologies or process options for development of remedial alternatives;
- Section 4.0, *Development and Evaluation of Remedial Alternatives* - summarizes the results of the technology/process option screening, presents the ground water modeling results used to assist in the

[3]~~-Note that the most aggressive alternatives were not developed in accordance with USEPA guidance (ref. USEPA, 1988) as described above, but rather were added to the detailed evaluation of alternatives at the direction of USEPA. Accordingly, these alternatives consist of component technologies or process options that may not have survived the technology screening process of a conventional FS. At the least, when subjected to a detailed evaluation, significant issues are raised relative to several of the technology screening criteria (e.g., "implementability" and "cost"). Nevertheless, the level of detailed evaluation performed is sufficient for evaluating the alternatives.~~

Discharge to Ground Water or Potable Supply Requirements

Discharges to ground water would need to conform with federal maximum contaminant levels (MCLs) for drinking water (40 CFR Part 141). TBCs for this action would be the federal secondary MCLs (40 CFR Part 143). Discharges to the Borough of Dublin municipal water supply system would need to be of sufficient quality that the municipal treatment system could reduce organic and inorganic constituents to MCLs and SMCLs.

Discharge to POTW or Surface Water Requirements (including the Municipal Storm Sewer)

Investigation of the sanitary sewer system and treatment capacity of the Borough of Dublin's publicly owned treatment works (POTW) indicated that up to a maximum of 14,000 gpd of additional flow can be accepted by the system[4]. The closest surface water discharge point would be Morris Run, a tributary of the East Branch of the Perkiomen Creek. This tributary has a classification for trout-stocked fisheries. The Dublin Borough municipal storm sewer represents another form of direct discharge (in addition to Morris Run) that could prove to be preferable to a direct discharge to Morris Run based on cost and property access issues (see Section 4.4)). At the likely point of discharge, Morris Run is believed to offer limited to no dilution capacity. The municipal storm sewer also offers no dilution capacity. Accordingly, applicable standards for surface discharge (either to Morris Run or the municipal storm sewer system) would be those contained in 25 Pa. Code Chapter 16 for toxic organics and metals, Chapter 93 for the majority of conventional parameters, and Chapter 95 for selected additional conventional parameters.

Off-site Disposal

Any off-site disposal of residuals that, based on analysis, would be classified as hazardous waste would need to comply with RCRA land disposal restrictions, including potential treatment requirements.

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[4] Note that expansion of the POTW to provide additional capacity is not retained as a viable option due to the combination of capital costs and routine use fees, which are considered excessive in comparison to other competing technologies/process options.

minimum, already reached a steady state condition (see Appendix A and Final RI Report - ERM, 1998)[5].

If additional measures are deemed necessary to achieve this RAO, or to resolve any uncertainties regarding plume dynamics, monitoring of sentinel wells may be an approach to accomplish this objective if the wells can be placed in locations that would allow sufficient time to implement additional remedial action to prevent further migration of the plume before adverse impacts occurred. Such an approach would provide a measure of protection for currently uncontaminated ground water and has been suggested by USEPA[2].

2.3.3 *Restoration of Ground Water to Beneficial Uses*

As previously discussed, restoration of ground water to beneficial uses is an expectation of USEPA "whenever practicable, within a timeframe that is reasonable given the particular circumstances of the site" (40 CFR 300). Since ground water in the vicinity of Dublin Borough is used for potable supply, restoration of the bedrock aquifer to allow potable use is deemed the optimal beneficial use. However, given the site-specific circumstances of the Dublin NPL Site, restoration of *all* contaminated ground water to potable water quality standards may ~~is~~ not be practicable. More specifically, the technical impracticability of restoring ground water to drinking water quality in the vicinity of the Dublin NPL Site is based on a combination of chemical (contaminant-related) and physical factors which characterize the Site. These factors, which are described in a general sense by USEPA (1993), are discussed below as they relate to the Site.

- Contaminant-related factors - DNAPL is likely present as indicated by empirical data (i.e., TCE concentrations $\geq$ 1% of its solubility limit in water), regardless of whether it occurs as free-phase liquid or as a residual material in the bedrock matrix of the aquifer. DNAPL in the subsurface will function as an ongoing source of TCE. Specifically, TCE concentrations were observed in ground water beneath the 120 Mill Street property in the range of 7,400 - 55,000 μg/l which is approximately equal to or possibly well in excess of one percent of

[5] EPA's position is that the plume may not be in steady state because the vertical extent of the plume is not known and the pumping scenarios have changed with the completion of OU1 (USEPA, 1999).

the TCE solubility limit in water (i.e., 1,100 mg/l to 1,470 mg/l) (Montgomery and Welkon, 1989). Also, DNAPL can adhere to solid material in the subsurface (i.e., soil and bedrock), and the slow rate of desorption of DNAPL from aquifer materials inhibits the effectiveness of ground water restoration. Furthermore, the solubility of the VOCs is orders of magnitude higher than the MCL (i.e., cleanup standard for beneficial use), so even if a significant mass of contaminants is removed, concentrations of remaining contaminants would likely exceed cleanup criteria.

- Hydrogeologic factors and aquifer properties - The aquifer impacted by the TCE plume is heterogeneous fractured bedrock. Contaminants may diffuse into small pore spaces or dead-end fractures within the bedrock aquifer, which complicates recovery or treatment of contaminated ground water for the purpose of ground water quality restoration (USEPA, 1993; MacDonald and Kavanaugh, 1994). Furthermore, ground water collection using wells is less efficient in heterogeneous formations than in more uniform materials because ground water flow toward recovery wells tends to occur primarily along higher conductivity materials or zones. As a result, zones of lower conductivity, which may contain significant quantities of contaminant mass, are bypassed (USEPA, 1992). As indicated previously, DNAPL also adheres to the aquifer matrix.
- Extent of contamination - Analytical results for ground water samples collected from discrete borehole interval samples identified relatively high levels of TCE at depth in the fractured bedrock aquifer. The maximum TCE concentration (55,000 μg/l) observed in any well was detected in the Fire Tower Well at a depth of 458-478 feet below the surface. These data combined with analytical data obtained since 1986 from the monitoring of residential and commercial supply wells indicate the distribution of TCE within the bedrock aquifer is laterally and vertically extensive.

In terms of the stated remedial action objectives, ground water restoration to beneficial uses is not necessary to provide protection of human health or the environment. Because source strength contamination (i.e., DNAPL) is likely to always remain in the ground water beneath the 120 Mill Street property, collection and treatment of ground water will not achieve MCLs in the portion of the bedrock aquifer that has been impacted. Consequently, restoration of all impacted ground water to its most beneficial use may not ~~cannot~~ be achievable (based on predictions of the solute transport model) ~~achieved~~[6].

[6] As discussed in Section 4, the restoration that is predicted to occur in the more ~~extreme~~ aggressive pumping scenarios is only finite - i.e., it is contingent upon the continuous and indefinite pumping of a source control well; otherwise, high-strength contamination would migrate from the source area and recontaminate those portions of the aquifer where restoration is predicted to occur.

Following review of the draft FS, USEPA directed Sequa to perform three additional solute transport simulations for three additional remedial pumping scenarios. For comparative purposes, in an attempt to determine whether any remedy would satisfy the RAO/expectation of aquifer restoration, each of the three additional simulations predicted the distribution of TCE over a 100-year time period (in contrast to the 30-year period modeled for the eight prior alternatives). A primary objective of the three additional simulations was to evaluate the feasibility of meeting the RAO/expectation of restoring the balance of the aquifer to drinking water quality (i.e., its beneficial use). The remedial scenarios include two primary components: complete source area containment, in conjunction with a pump-and-treat component for the downgradient dissolved phase plume. The pump-and-treat component was evaluated using a range of pumping scenarios that included adjustments in the pumping rate of the OU1 supply well and as many as 12 downgradient extraction wells.

The three additional remedial scenarios modeled were as follows:

- Alternative 4C - pumping a source area well at 20 gpm and the OU1 supply well at 40 gpm. The objective of this simulation was to depict the plume configuration over time when there is complete hydraulic containment of the source area and the OU1 well is pumping at the rate specified in the Record of Decision for OU1.

- Alternative 7 - pumping a source area well at 20 gpm, OU1 at 20 gpm, and three downgradient wells (EW-3, EW-5 and EW-10) each pumping at 5 gpm. The objective of this simulation was to depict the plume configuration over time when there is complete hydraulic containment of the source area, and extraction wells are situated to remove contaminant mass in areas between the source area and the OU1 well.

- Alternative 8 - pumping a source area well at 20 gpm, OU1 at 20 gpm, and 12 downgradient wells (EW-2 through EW-12) each pumping at 5 gpm. The objective of this simulation was to evaluate whether the timeframe for achieving aquifer restoration can be expedited with an ~~extreme~~ aggressive pumping scheme.

All ground water modeling focused on predicting the future migration of the TCE plume for each remedial pumping scenario being evaluated. The modeling reports (initial report dated September 1999 and subsequent report dated March 2000) and associated graphics are contained in Appendix B, and a summary of the modeling efforts is presented below.

Fenton's reagent and ozone were eliminated from further consideration for this alternative because these oxidants are problematic for subsurface injection. Fenton's reagent generates heat and gas, which can make the reaction difficult to control, thus creating operational and health and safety concerns. Also, the hydroxyl radicals generated by the reaction are relatively short-lived. Ozone is also problematic with respect to handling and operational concerns. Unreacted ozone gas escaping from the saturated zone can require use of a vapor collection and treatment, thus complicating its use.

Additional Alternatives

Following review of the draft FS by USEPA and PADEP, USEPA directed Sequa to incorporate within the FS three additional remedial alternatives. These additional alternatives are described in detail in the following sections. ~~It is important to note that these additional alternatives were not developed through the conventional FS process of screening candidate technologies and process options, and then assembling complete remedial alternatives based on the results of the technology screening. Instead,~~ These alternatives were identified by USEPA as scenarios that should be modeled to assess their performance with regard to the RAOs/expectations of source control and aquifer restoration. ~~Subjecting these alternatives to a detailed FS evaluation without the benefit of the technology screening process results in the identification of significant issues relative to several of the technology screening criteria (e.g., implementability and cost) (See Section 4.6).~~

4.4.7 Alternative 4C - Pumping OU1 Supply Well @ 40 gpm and a Source Area Well @ 20 gpm

Conceptually, Alternative 4C is the same as Alternative 4 except for the higher pumping rate of the source area well. The pumping rate for the source area well would be increased from 5 gpm to 20 gpm to achieve complete hydraulic containment of source material (i.e., the portion of the TCE plume with concentrations greater than or equal to 10 ppm). Complete hydraulic containment of the source material in the vicinity of the 120 Mill Street property is intended to facilitate restoration of the remaining portion of the aquifer beyond the source area.

Ground water recovered from the source area well near 120 Mill Street will require treatment prior to discharge. In contrast with Alternative 4, the higher pumping rate for this alternative will produce four times as much water to be treated and discharged. Of the two ex-situ treatment

4.4.9 *Alternative 8 - Pumping OU1 Supply Well @ 20 gpm and a Source Area Well @ 20 gpm, and 12 Downgradient Wells at 5 gpm*

Alternative 8 is intended to be an ~~extreme~~ aggressive pumping scenario to determine if aquifer restoration can be achieved at all. This alternative is the same as Alternative 7 except that the total number of downgradient wells would be increased from three to 12 wells located between the source area well and the OU1 supply well (see EW-1 through EW-12 on Figure 1 of Appendix B-2). Each of the 12 downgradient wells would be pumped at 5 gpm. Including the source area well and the OU1 supply well, this alternative would have a total of 14 recovery wells that achieve a combined total ground water withdrawal of 100 gpm from the bedrock aquifer. Because ground water withdrawal would exceed 10,000 gpd, review by DRBC would be required. DRBC ~~review/approval~~ could have ~~be~~ even more concerns ~~of an issue~~ (in comparison to prior alternatives - e.g., Alt #4C and 7) due to the ~~a~~ total withdrawal and volume of water unavailable for public use. ~~non-beneficial use of more than ten times (>10x) the allowable DRBC limit.~~

The combined pumping rate for the source area well and 12 downgradient wells would produce a combined flow rate of 80 gpm of contaminated ground water that must be treated and discharged. For the same reasons discussed in Section 4.4.8 for Alternative 7, the extracted ground water from the 12 downgradient recovery wells would be manifolded and conveyed to the source area treatment system. Also, similar to Alternative 7, the reduced pumping rate of the OU1 supply well would require the Borough to adjust the pumping rate of an existing supply well or install a new supply well to account for the loss of 20 gpm in the Borough's distribution system.

The differences between Alternative 8 and Alternative 7 in terms of conceptual design are as follows:

- the source area treatment system and effluent pipeline would need to be sized to accommodate a total flow of 80 gpm;
- twelve bedrock extraction wells would need to be located, installed and confirmed for capacity, or constructed from existing wells (assumed to be 6-inch diameter and approximately 450 feet in depth) (along with the acquisition of permanent property access); and
- a collection and conveyance pipeline (i.e., manifold system) to collect the extracted ground water from 12 separate locations and route it to

technologies (i.e., air stripping and chemical oxidation using permanganate) retained during the remedial technology screening step, air stripping was selected as the ex-situ treatment technology for this alternative. This technology would be cost-effective in removing a significant percentage of the contaminant mass from the ground water.

Communications with Dublin Borough indicate that the maximum available capacity of the Borough's municipal wastewater collection and treatment system is approximately 14,000 gpd, which is equivalent to approximately 10 gpm. Consequently, discharge of the effluent to the POTW (as was recommended for Alternative 4) is not a viable option for Alternative 4C. (Additionally, the capital cost necessary to expand the capacity of the POTW, in conjunction with routine sewer use fees, causes this option to be excessively costly in comparison to direct discharge.) The effluent from the treatment system would therefore need to be discharged either to a surface water that has adequate hydraulic capacity to receive the additional flow to avoid localized flooding, or possibly to the Dublin Borough municipal storm sewer system. The nearest surface water that is considered to have sufficient hydraulic capacity is Morris Run, located approximately one mile to the west/southwest of the 120 Mill Street property. Communications with Dublin Borough indicated that it would be acceptable to discharge the treated effluent to the Borough's storm sewer system, which runs within approximately 100 feet of the 120 Mill Street property. Evaluation of design information for the storm sewer system provided by the Borough indicated that the storm sewer system, which consists of a series of buried culverts and open vegetated swales, has sufficient hydraulic capacity to receive the effluent from the treatment system without compromising the system's ability to convey stormwater from peak events. For purposes of facilitating the connection of the discharge pipe to the storm sewer and for routine monitoring of the effluent, it is assumed that a junction manhole would be required. ~~To minimize the need for private property access, the effluent pipeline would be routed along public roadways to the maximum extent practicable. It is also possible that a pumping station would be required to convey the treated effluent to Morris Run.~~

Direct discharge of the treated effluent (either to Morris Run or the storm sewer) would be in accordance with the requirements of an NPDES permit (although an actual permit would not be needed). Discharge limits for a direct discharge would be much more stringent than for the indirect discharge to the POTW contemplated in Alternative 4. Consequently, additional treatment of the effluent following treatment via the air stripper would likely be required. Typically, "effluent polishing" is health and the environment, compliance with ARARs and prevention of plume migration. This alternative would not address the additional RAOs for source control or restoration of ground water to beneficial uses as predicted by the solute transport model. Residual contamination exceeding MCLs would remain in the bedrock aquifer after implementation of this alternative. The combination of a permanent and reliable water supply, additional institutional controls (i.e., deed restrictions), and a long-term ground water monitoring plan designed to support the remedy and assess future conditions would effectively address current and future risks.

Ground water modeling results indicate this alternative is likely to prevent migration of the plume. Although this alternative would not reduce the lateral extent of the plume, the hydraulic influence of the OU1 supply well appears to prevent further migration of the plume downgradient of the OU1 well. A time versus concentration graph for TCE (see Attachment 2 of Appendix B1) indicates this alternative would prevent TCE concentrations from approaching the MCL at the Dublin Acres wells (and nearby Dublin Borough Well No. 3) located downgradient of the OU1 supply well. Additionally, this alternative is predicted to result in reduced concentrations of TCE (in comparison to Alternative 1) reaching the OU1 supply well. Increased pumping of the OU1 supply well is predicted to have the effect of diluting contamination by pulling more clean water from the portion of the aquifer to the north that has not been impacted by TCE.

4.5.3.4 *Reduction of Toxicity, Mobility or Volume*

Alternative 3 would reduce the toxicity, mobility or volume of the TCE plume in the same manner as described for Alternative 2. The higher pumping rate for the OU1 supply well would exert hydraulic influence over a larger area of the aquifer, thus capturing a greater portion of the leading edge of the plume. Although the higher pumping rate for this well would likely increase the contaminant mass removed from the plume, the mass removed would still be minimal relative to the total mass contained in the plume. In addition, due to preferential capture of clean water from portions of the aquifer not impacted by TCE (as discussed in 4.5.3.3 above), the additional amount of contaminated ground water removed in comparison to Alternatives 1 and 2 would be minimal. Also, the suspected DNAPL source and dissolved phase contamination would remain in the bedrock aquifer at levels exceeding MCLs after implementation of this alternative.

long-term risk, Alternative 6 has a higher level of risk associated with its implementation (see Section 4.5.6.5 -- short-term effectiveness).

4.5.6.2 *Compliance with Potential ARARs*

Alternative 6 is considered to be compliant with all ARARs. The in-situ treatment contemplated by Alternative 6 would eliminate the need for pretreatment and a discharge permit for discharges to the POTW or treatment/permitting associated with air emissions. Like other alternatives considered in this FS, however, and despite the implementation of what is viewed as a very aggressive treatment technology, concentrations of TCE above the MCL are predicted to persist throughout most of the plume for at least 30 years. Therefore, this alternative would not achieve drinking water standards within a reasonable timeframe; rather, the eventual (i.e., indefinite) cleanup of ground water to drinking water standards would only occur via the continued operation of the OU1 supply well/treatment system in conjunction with natural attenuative processes.

4.5.6.3 *Long-term Effectiveness and Permanence*

This alternative would provide long-term effectiveness and permanence, and would be effective in meeting the RAOs for protection of human health and the environment, compliance with ARARs and prevention of plume migration. This alternative would also address the additional RAO of source control, although the degree of source control may not be complete (i.e., residual source strength material would likely remain in the bedrock aquifer after treatment is completed). The combination of a permanent and reliable water supply, additional institutional controls, long-term ground water monitoring, and in-situ treatment for source control would address current and future risks. Residual contamination exceeding MCLs would remain in the bedrock aquifer after implementation of this alternative; therefore, the RAO/expectation of restoring the aquifer to beneficial use (i.e., drinking water supply) would not be achieved within a reasonable timeframe, as predicted by the solute transport model.

In-situ treatment of the source area would reduce source area concentrations of contaminants in ground water near the 120 Mill Street property, which would address at least to some degree, the RAO for source control. As indicated by the ground water modeling results (see Figures 61 through 66 in Appendix B1), in-situ treatment of the source area would eventually result in lower TCE concentrations throughout the a substantial decrease in source strength concentrations. Pre- and post-monitoring would be required for each injection event to monitor the effectiveness of the treatment process.

4.5.6.7 *Cost*

Table 6 of Appendix C (Detailed Cost Estimates) presents a detailed breakout of the estimated costs for Alternative 6 (including significant assumptions). The total estimated costs for this alternative are:

Initial Capital Cost	$264,800
Annual O&M (Years 1 through 5)	$ 43,900
Annual O&M (Years 6 through 30)	$ 22,000
Net Present Value (30 years at 7%)	$627,600

4.5.6.8 *State Acceptance*

This criterion will be evaluated during review of the FS by PADEP.

4.5.6.9 *Community Acceptance*

This criterion will be evaluated during review of the PRAP (i.e., public comment period).

4.6 *EVALUATION OF ADDITIONAL ALTERNATIVES*

As mentioned previously, following review of the draft FS by USEPA and PADEP, USEPA directed Sequa to incorporate three additional remedial alternatives into the FS. These additional alternatives are described in detail in Section 4.4 and are evaluated in the following sections. ~~It is important to note that these additional alternatives were not developed through the conventional FS process of screening candidate technologies and process options, and then assembling complete remedial alternatives based on the results of the technology screening. Instead,~~ These alternatives were identified by USEPA as scenarios that should be modeled to assess their performance with regard to the RAOs/expectations of source control and aquifer restoration. ~~Subjecting these alternatives to a detailed FS evaluation without the benefit of the technology screening process results in the identification of significant issues relative to several of the technology screening criteria (e.g., implementability and cost).~~

4.6.1 *Alternative 4C[11] - OU1 (at 40 gpm) and a Source Area Well (at 20 gpm)*

4.6.1.1 *Overall Protection of Human Health and the Environment*

Similar to Alternative 4, Alternative 4C would provide a very good level of human health protection. In addition to OU1, which effectively addressed any imminent risks to human health and the environment, complete hydraulic containment of source material would effectively eliminate the continued migration of high levels of contamination and thereby reduce the maximum contaminant concentrations expected to reach the OU1 supply well, the Dublin Acres community wells, and Dublin Borough Well #3. However, in contrast to Alternative 4, which contemplated discharge of the extracted ground water to the POTW, Alternative 4C entails direct discharge of the extracted ground water from the source area (following treatment) to ~~Morris Run~~ the municipal storm sewer system. Therefore, additional risks could result via exposures to ~~Morris Run~~ surface water (by human or ecological receptors) if upsets to the treatment system were to occur.

4.6.1.2 *Compliance with Potential ARARs*

Alternative 4C is expected to be compliant with all ARARs. Due to the reduced contaminant concentrations expected to reach the water supply wells of Dublin Borough (i.e., OU1 and Well #3) and the Dublin Acres community wells, compliance with the Safe Drinking Water Act should not be an issue.

However, in contrast to Alternative 4, direct discharge of the effluent to the ~~Morris Run~~ municipal storm sewer system (rather than indirect discharge to the POTW under Alternative 4) increases the level of treatment required and heightens the need for effective treatment. Discharge to ~~Morris Run~~ the storm sewer would be in accordance with the discharge limits and monitoring terms of an NPDES permit. And although compliance is expected, there is a greater possibility of non-compliance under Alternative 4C than Alternative 4 due to the more stringent requirements associated with a direct discharge to waters of the Commonwealth.

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[11] The reader is referred to Appendix B1 for a discussion of Alternatives 4A and 4B.

This alternative would also remove contaminant mass due to the pumping of a well within the source area, along with the downgradient pumping of the OU1 supply well. However, the suspected DNAPL source and dissolved-phase contamination would remain in the bedrock aquifer at levels exceeding MCLs for an extended period time (e.g., >30 years in the vicinity of the OU1 supply well).

4.6.1.5 *Short-Term Effectiveness*

As with Alternative 4, Alternative 4C would involve installation of a new recovery well or reconstruction of an existing well at the 120 Mill Street property, routine O&M of the source area recovery well and treatment system, along with routine O&M of the OU1 well and treatment system. In contrast to Alternative 4, Alternative 4C would entail ~~the construction of an effluent pipeline from the 120 Mill Street site to Morris Run (approximately one mile)~~ discharge to the Dublin Borough municipal storm sewer system rather than the Borough's POTW (i.e., a direct rather than indirect discharge). There is potential for adverse short-term effects to construction workers due to the increased potential for exposure to DNAPL concentrations of TCE during construction/reconstruction of the recovery well and during construction of the on-site treatment system. ~~There is also an increased risk to public health and environmental receptors from possible leaks or breaches in the effluent pipeline. Finally, any upsets in the treatment system would result in~~ In addition, there is also a greater potential (in comparison to alternatives involving discharge to the POTW) for adverse short-term effects to water quality and ecological receptors ~~in Morris Run~~ from possible upsets in the treatment system.

4.6.1.6 *Implementability*

The pumping test conducted during the RI showed that the Fire Tower Well has a sustainable yield of at least 25 gpm so there should be no problem in pumping a source area well (possibly the Fire Tower Well) at a continuous rate of 20 gpm. Although treatment of the extracted ground water would be possible, the level of treatment required (and therefore the costs) would be significantly greater than that required either for the OU1 supply well or that contemplated in Alternative 4 due to the concentration of contaminants and the more stringent discharge requirements (i.e., direct vs. indirect discharge). In addition to stringent discharge limits, all other substantive aspects of an NPDES permit would also apply to the direct discharge of the extracted ground water to ~~Morris Run~~ the municipal storm sewer system. Finally, Alternative 4C would require the

4.6.1.7 Cost

Table 7 of Appendix C (Detailed Cost Estimates) presents a detailed breakout of the estimated costs for Alternative 4C (including significant assumptions). The total estimated costs for this alternative are:

Initial Capital Cost	$ ~~205,100~~ <u>105,200</u>
Annual O&M (years 1 through 5)	$ 88,700
Annual O&M (years 6 through 30)	$ 66,800
Net Present Value (30 years at 7%)	~~$1,123,800~~ <u>1,023,900</u>

4.6.1.8 State Acceptance

This criterion will be evaluated during review of the FS by PADEP.

4.6.1.9 Community Acceptance

This criterion will be evaluated during review of the PRAP (i.e., public comment period).

4.6.2 *Alternative 7 - Source Area Well at 20 gpm, Reduced Pumping of the OU1 Well (20 gpm), and Three Downgradient Recovery Wells (5 gpm each)*

4.6.2.1 Overall Protection of Human Health and the Environment

Alternative 7 is protective of human health and the environment to the same extent as Alternative 4C, with several notable exceptions. The similarities are: 1) the successful implementation of the OU1 remedy has effectively addressed any imminent risks to human health and the environment; 2) complete hydraulic containment of source material would effectively eliminate continued migration of high levels of contamination, thereby reducing the maximum concentration of contaminants expected to reach the OU1 supply well; and 3) the direct discharge of the extracted ground water from the source area to ~~Morris Run~~ <u>the storm sewer</u> (following treatment) could result in exposures to ~~Morris Run~~ <u>contaminants in surface water</u> (by human or ecological receptors) if upsets ~~to~~ the treatment system were to occur.
in

One notable difference between Alternative 7 and 4C relative to the overall protection of human health and the environment is in the levels of contamination expected to reach the Dublin Acres community wells and Dublin Borough Well #3 in the future. After approximately 30 years, the years. In addition, Table 6 also presents the model-predicted timeframe for achieving MCLs, if feasible, at select locations throughout the plume.

With regard to the permanence of Alternative 7, it will remain protective of human health and the environment due to the successful implementation of the OU1 remedy. However, it is important to note that the effectiveness in achieving source control and the extent of aquifer restoration predicted to be achieved are contingent upon the continuous and indefinite pumping of the source control well. Otherwise, high-strength contamination would migrate from the source area and recontaminate those portions of the aquifer where restoration is predicted to occur.

4.6.2.4 *Reduction of Toxicity, Mobility or Volume*

Like Alternative 4C, Alternative 7 would significantly reduce the mobility of high strength contamination by achieving complete hydraulic control of the source area. Complete hydraulic control of source material would also significantly reduce the volume of ground water contamination by eliminating the continued migration of dissolved-phase TCE beyond the source area.

However, as discussed in 4.6.2.2 above, the reduced pumping of the OU1 supply well appears to have off-setting effects in terms of contaminant mobility. One, it contributes to greater control (i.e., limited migration) of source material and high-strength contamination proximal to the source area. But it also appears to result in increased migration (mobility) of lower levels of contamination, with the consequence of potentially experiencing MCL exceedances at the Dublin Acres community wells and Dublin Borough Well #3.

4.6.2.5 *Short-Term Effectiveness*

The short-term effectiveness of Alternative 7 is deemed to be similar to that of Alternative 4C. All imminent risks to human health have been effectively addressed via the successful implementation of the OU1 remedy. However, the potential for worker exposure exists during the construction of the source area well and treatment system. ~~Additionally, there would be increased risks to the public and ecological receptors from either breaches in the effluent pipeline and/or upsets in the treatment system that could cause elevated contaminant concentrations to reach Morris Run.~~ Similar to Alternative 4C, there is a potential for adverse effects to human health or ecological receptors in the event of any upsets to the treatment system due to the fact that the effluent from the treatment system is discharged directly to the storm sewer system (in contrast to indirect discharge to the POTW). Additionally, and in comparison to Alternative 4C, the potential for adverse impacts to human health or the environment could result from breaches in the ground water collection and conveyance system (though the likelihood of such an incident is considered low). The timeframe required to complete the implementation of Alternative 7 would be expected to be longer than Alternative 4C due to the need to acquire permanent property access and install three downgradient recovery wells and a collection/conveyance system.

4.6.2.6 *Implementability*

The implementability of Alternative 7 is also assessed to be identical to Alternative 4C, with one notable exception. The ability to obtain permanent access, either via easements or outright purchase, of appropriate properties (i.e., locations) to install the downgradient recovery wells is uncertain. The difficulties encountered during the RI for installation of monitoring wells, which only required finite access, are expected to be worse for obtaining access to construct and operate recovery wells indefinitely. For these reasons, outright purchase of the necessary properties was assumed for cost estimating purposes (see Appendix C). The potential property access issue would be further compounded by the need to convey contaminated ground water across multiple properties to the treatment system located at the source area.

4.6.2.7 *Cost*

Table 8 of Appendix C (Detailed Cost Estimates) presents a detailed breakout of the estimated costs for Alternative 7 (including significant assumptions). The total estimated costs for this alternative are:

select locations throughout the plume, and for select time intervals up to 100 years. In addition, Table 6 also presents the model-predicted timeframe for achieving MCLs at select locations throughout the plume.

With regard to the permanence of Alternative 8, as noted previously for Alternatives 4C and 7, the extent of aquifer restoration predicted to be achieved by Alternative 8 is contingent upon the continuous and indefinite pumping of the source control well.

4.6.3.4 *Reduction of Toxicity, Mobility or Volume*

Alternative 8 reduces the mobility and volume of ground water contamination to the greatest extent in comparison to all other alternatives evaluated. As with Alternative 7, this reduction in contaminant mobility and volume is achieved through a combination of complete source control and a number of downgradient recovery wells. However, because the reduction in contaminant mobility and volume is contingent upon the continuous and indefinite pumping of these wells, especially the source control well, the beneficial effects of Alternative 8 are considered reversible - i.e., high strength contamination would be expected to migrate from the source area and recontaminate those portions of the aquifer where restoration is predicted to occur should the source area well (and possibly some or all of the downgradient recovery wells) cease operation.

4.6.3.5 *Short-Term Effectiveness*

The short-term effectiveness of Alternative 8 is deemed to be ~~identical~~ similar to that of Alternative 4C and 7 (see Sections 4.6.1.5 and 4.6.2.5). A distinction between Alternative 8 and Alternatives 4C and 7 would be that the likelihood of a breach in the ground water collection and conveyance system would be slightly higher (though still considered an unlikely event) due to the increased complexity and length of piping required to collect the contaminated ground water from the 12 extraction wells. It is also noted~~, however,~~ that the timeframe for implementing the alternative, due to the anticipated difficulties related to obtaining property access, would be even longer than that for Alternative 7.

4.6.3.6 *Implementability*

The implementability of Alternative 8 is assessed to be very similar to Alternative 7. The only difference is the number of properties required for the installation/construction of the downgradient recovery wells, and the

5.0 *COMPARATIVE ANALYSIS OF ALTERNATIVES*

The following section provides a comparative analysis of the nine candidate remedial alternatives (i.e., six initial alternatives and three additional alternatives incorporated at USEPA's direction) based on the results of the detailed evaluation of the alternatives against the nine evaluation criteria presented in Section 4. Consistent with USEPA guidance (USEPA, 1988), this FS does not recommend a particular alternative, but rather via this comparative analysis provides an objective evaluation of the alternatives within the context of the nine evaluation criteria identified in the NCP. Table 7 summarizes the results of this comparative analysis.

~~Note that the three alternatives added at USEPA's direction were not developed in accordance with USEPA guidance (ref. USEPA, 1988), but rather were added to the detailed evaluation of alternatives at the direction of USEPA. Accordingly, these alternatives consist of component technologies or process options that may not have survived the technology screening process of a conventional FS. At the least, when subjected to a detailed evaluation, significant issues are raised relative to several of the technology screening criteria (e.g., "implementability" and "cost"). Nevertheless, the level of detailed evaluation performed is considered sufficient for conducting a comparative analysis of these alternatives relative to other candidate alternatives. However, if these alternatives are considered beyond this FS, additional detailed analysis would be required to confirm their feasibility and implementability.~~

Several general observations made as a result of the comparative analysis are as follows:

- All alternatives satisfy the threshold criterion of being protective of human health and the environment under current conditions, and the combination of institutional controls and routine monitoring provide protection in the future;

- All alternatives are also expected to be fully compliant with all potential ARARs; however, due to the need for a direct discharge of the effluent from a source area treatment system under Alternatives 4C, 7 and 8, there would be an increased potential for violations of the Clean Water Act (CWA). Additionally, the collection and conveyance of contaminated ground water through portions of the Borough under

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Initial Capital Cost	$ ~~1,027,900~~ 636,500
Annual O&M (years 1 through 5)	$ 99,100
Annual O&M (years 6 through 30)	$ 77,200
Net Present Value (30 years at 7%)	~~$2,075,700 NF~~[12] ≥ 1,684,300[12]

4.6.2.8 *State Acceptance*

This criterion will be evaluated during review of the FS by PADEP.

4.6.2.9 *Community Acceptance*

This criterion will be evaluated during review of the PRAP (i.e., public comment period).

4.6.3 *Alternative 8 - Source Area Well (at 20 gpm), Reduced Pumping of the OU1 Well (20 gpm), and Twelve Downgradient Recovery Wells (at 5 gpm each)*

4.6.3.1 *Overall Protection of Human Health and the Environment*

Alternative 8 is protective of human health and the environment to the same extent as the other alternatives (due to the successful implementation of the OU1 remedy). Via modeling simulations, Alternative 8 is predicted to restore the aquifer to the greatest extent of all the alternatives evaluated. This implies that the residual risk would be less than for all other alternatives; however, it is important to note that the restoration (and therefore risk reduction) achieved by this alternative (as well as the other additional alternatives evaluated) is contingent upon continuous and indefinite operation of the source control well and possibly the downgradient recovery wells. Additionally, high strength contamination (including DNAPL) would remain within the source area indefinitely, although a combination of engineering and institutional controls would be effective in eliminating exposure to contamination within the source area.

[12] ~~NF = Not feasible. Estimated costs likely reflect the lower end of a cost range; due to numerous implementability issues, the upper end of the cost range would be the conclusion that the alternative is not implementable at any cost.~~ In comparison to the other alternatives evaluated, the complexity of design associated with this alternative causes the estimated cost to be less accurate than the other cost estimates and, in all likelihood, reflects the lower end of a cost range.

It is also noted that, similar to Alternative 7, the need to collect and convey contaminated ground water throughout portions of the Borough introduces another source of risk to human health and the environment, but to an even greater extent than Alternative 7.

4.6.3.2 *Compliance with Potential ARARs*

Like all of the other alternatives evaluated, Alternative 8 is expected to be compliant with all ARARs. The enhanced aquifer restoration afforded by the twelve downgradient recovery wells results in model predictions that MCLs should not be exceeded at any time in the future at the OU1 supply well, the Dublin Acres community wells, or Dublin Borough Well #3; therefore compliance with the Safe Drinking Water Act should not be an issue.

However, similar to Alternatives 4C and 7, direct discharge of the treated effluent from the source area treatment system to ~~Morris Run~~ the storm sewer increases the potential for violations of the Clean Water Act (in comparison to alternatives that involve indirect discharge of the treated effluent ~~any of the initial alternatives evaluated~~).

4.6.3.3 *Long-Term Effectiveness and Permanence*

Alternative 8 is effective in terms of meeting the threshold criteria of being protective of human health and the environment and being compliant with ARARs. Alternative #8 also provides the greatest effectiveness of all alternatives evaluated relative to the additional RAOs/expectations of source control and aquifer restoration. As expected, model simulations (see Appendix B2) indicate that the incorporation of twelve downgradient recovery wells, in conjunction with the other components of Alternative 8, removes the greatest amount of contaminant mass in less time than any of the other alternatives evaluated.

Despite the extent of aquifer restoration predicted, complete restoration of the aquifer to its beneficial use is still not predicted to occur by the solute transport model, even though as discussed in Section 4.3 the model overestimates the actual effectiveness of pump-and-treat technology in a bedrock aquifer. Specifically, the model predicts that TCE impacted ground water with a peak concentration of 100 μg/l would extend approximately 500 feet downgradient of the source area in Model Layer 2 after 30 years of remedial pumping, and TCE-impacted ground water (i.e., 1-5 μg/l) would extend approximately 1,400 feet downgradient of the source area in Model Layer 5 after 100 years (see Appendix B2). Table 6 collection/conveyance piping would be roughly four times greater for Alternative 8 than Alternative 7. ~~If possible at all, t~~The time and costs (see Section 4.6.3.7) required to obtain the necessary property access are considered to be ~~excessive in comparison to~~ significantly greater than the total implementation timeframe and costs for other alternatives evaluated.

4.6.3.7 *Cost*

Table 9 of Appendix C (Detailed Cost Estimates) presents a detailed breakout of the estimated costs for Alternative 8 (including significant assumptions). The total estimated costs for this alternative are:

Initial Capital Cost	~~$4,699,200~~ 2,807,200
Annual O&M (years 1 through 5)	$ 118,800
Annual O&M (years 6 through 30)	$ 96,900
Net Present Value (30 years at 7%)	~~$5,991,400 NF[13]~~ ≥ 4,099,400[13]

4.6.3.8 *State Acceptance*

This criterion will be evaluated during review of the FS by PADEP.

4.6.3.9 *Community Acceptance*

This criterion will be evaluated during review of the PRAP (i.e., public comment period).

[13] See Footnote 12.

accurately simulate the effectiveness of pump-and-treat technology in restoring ground water quality in bedrock aquifers is limited. Therefore, due to the uncertainties common to all ground water modeling, especially under the conditions that exist at the Dublin site, decisions regarding the need for remediation and distinctions between remedial scenarios should be based upon empirical data to the maximum extent practicable (i.e., past and future ground water monitoring results).

5.1 *COMPARISON OF THRESHOLD CRITERIA*

As shown on Table 7, the threshold criteria are: *overall protection of human health and the environment* and *compliance with ARARs*.

Each of the alternatives meets the threshold criterion of being protective of human health and the environment. This is primarily because OU1 (i.e., Alternative #1), which had as its objective providing a reliable source of potable water to all residences and businesses whose supply wells had been or could potentially be impacted by contaminated ground water, was successfully implemented, thereby eliminating all risks under current conditions. And based on the findings of the RI and BLRA, the successful implementation of OU1, which includes existing institutional controls and a long-term monitoring program, is projected to be protective of human health and the environment under future conditions.

The primary distinction between the alternatives with regard to protection of human health and the environment relates to the maximum contaminant concentrations predicted to reach certain downgradient supply wells in the future - specifically, Borough supply wells #3 and #5 (OU1), and the Dublin Acres community wells. Alternatives 1, 2 and 6 are the only alternatives where the temporal trend after 30 years does not assure that MCLs would not be exceeded at the potential receptor wells downgradient of the OU1 supply well; however, asymototic trends are indicated, which means that the maximum concentrations predicted to occur at these locations are not expected to be significantly higher than the MCL. Also, due to the reduced pumping of the OU1 supply well in Alternative 7, concentrations of TCE approaching the MCL are predicted to reach the downgradient supply wells after approximately 30 years. Alternative 5 is predicted to result in increased lateral spread of the contaminant plume in comparison to the other alternatives, which could result in an increased potential for exposures beyond the current public water distribution system. All other alternatives are considered to be fully protective of potential receptor wells without reservation (based on the predictions of the solute transport model).

Although all alternatives are expected to be fully compliant with all potential ARARs, an increased potential for non compliance with several ARARs exists for several of the alternatives evaluated. Potential non-compliance with the Safe Drinking Water Act would result from concentrations of TCE reaching several supply wells downgradient of the OU1 well - specifically, Borough Well #3 and the Dublin Acres community supply wells. This potential for non-compliance with an ARAR was discussed above as it relates to overall protection of human health and the environment.

It should be noted, however, that the potential for exceeding MCLs was identified based on the TCE concentrations predicted by the solute transport model to reach those well locations in the future (10 to 30 years in the future). As discussed in Section 4.5, the modeling prediction that a concentration of TCE above the MCL at a well point would not necessarily result in an exceedance of the MCL in the water supply well or public distribution system due to the volume of clean water within the well's capture zone and the volatilization that would occur within the well. Additionally, it should be noted that well head treatment (or treatment upgrades in the case of the OU1 system) could be easily implemented to ensure compliance with the SDWA at these locations.

Another potential for non-compliance with an ARAR that warrants discussion is the increased potential for non-compliance with the Clean Water Act (CWA) which could result from exceedances of the direct-discharge limits for Alternatives 4C, 7 and 8. These three alternatives, which were incorporated into the FS at the direction of USEPA following their review of the draft FS, are the only alternatives which require a direct discharge of treated ground water to surface water. The volume of ground water being extracted in these alternatives exceeds the hydraulic capacity of the POTW and therefore direct discharge to ~~Morris Run~~ to the municipal storm sewer system are considered ~~via an approximate one-mile pipeline was considered~~ the best discharge option[14]. The stringent discharge limits of a direct discharge (i.e., NPDES permit conditions) in combination with the high levels of contamination within the contaminant source area, emphasizes the need for an appropriately designed and

[14] See Footnote #4.

of this alternative was the possible need to change the OU1 well pump to achieve the higher pumping rate, along with the possibility of other minor modifications to the existing OU1 recovery/treatment system.

All other alternatives, except Alternative 6, were viewed less favorably in terms of the short-term effectiveness criterion because they involve additional ground water recovery and treatment; although construction activities would be expected to be completed in a finite timeframe (months to possibly several years), the system would need to operate indefinitely. Note that the design/construction timeframe for Alternative 8 could be especially protracted due to the need to obtain indefinite access to at least 12 private properties, (assuming the necessary accesses could be acquired at all). Also note that the potential for risks to workers was considered greater for Alternatives 4, 4C, 7 and 8 due to potential exposure to high concentrations of contaminants (DNAPL) during the construction of the source area extraction well and treatment system. A similar concern existed for Alternative 6 due to potential worker exposure to a strong oxidizing agent.

One significant observation relative to *implementability* is that Alternatives 1 and 2 have essentially already been successfully implemented (it is noted that Alternative 2 would require execution of a deed restriction on the 120 Mill Street property, but this is considered a relatively simple administrative procedure). Additionally, implementation of Alternative 3 is considered very easy to successfully implement because the OU1 system has been determined to have sufficient capacity to accommodate the increased pumping, with the possible exception of some minor modifications to the existing OU1 recovery and treatment system.

Alternative 4 is also considered to be a good alternative in terms of its implementability. Although it would require installation or construction of a source area recovery well, candidate wells already exist at the 120 Mill Street property. Additionally, the effluent from the recovery well could be discharged to the local POTW. In contrast, Alternatives 4C, 7 and 8 are considered progressively more difficult to implement. Each would require that the treated effluent be discharged either to a local surface water or to the municipal storm sewer (a direct discharge) ~~the construction of an approximate one mile effluent pipeline to convey the effluent from the source area recovery and treatment system to Morris Run~~ because the volume of ground water extracted exceeds the capacity of the POTW. Alternatives 7 and 8 would also require acquisition of indefinite private property access for the installation and construction of the downgradient recovery wells and the collection/conveyance system.

Table 7 Comparative Analysis of Alternatives

Continued on Page 2

Criteria	Alternative No. 1 No Further Action	Alternative No. 2 Limited Action	Alternative No. 3 Increased Pumping of OU1 Supply Well	Alternative No. 4 OU1 (@40 gpm) and a Source Area Well @ 5 gpm	Alternative 4C OU1 (@40 gpm) and a Source Area Well @ 20 gpm
1. *Overall Protection of Human Health and the Environment*	*Acceptable* - No unacceptable risks under current conditions; institutional controls and routine monitoring provide protection in the future.	*Good* - No unacceptable risks under current conditions; institutional controls and routine monitoring provide protection in the future; additional institutional controls (deed restriction) provide greater level of protection in the future and revised monitoring program provides more useful information for characterizing plume extent, remedy performance and potential risks to human health.	*Very Good* - Same as Alt #2 with greater protection to municipal and community supply wells (i.e., reduced contaminant concentrations predicted at OU1, Dublin Borough Well #3, and Dublin Acres wells).	*Very Good* - Same as Alt #2 with greater protection to municipal and community supply wells (i.e., reduced contaminant concentrations predicted at OU1, Dublin Borough Well #3, and Dublin Acres wells).	*Very Good* – Same as Alt #4, but even lower concentrations predicted at OU1, Dublin Borough Well #3, and Dublin Acres wells as a result of complete hydraulic containment of source material.
2. *Compliance with ARARs/TBCs*	*Acceptable* - Fully compliant. Remote potential for non-compliance with SDWA at Borough Wells #3 and 5, and Dublin Acres community well.	*Acceptable* - Fully compliant. Remote potential for non-compliance with SDWA at Borough Wells #3 and 5, and Dublin Acres community well.	*Acceptable* - Fully compliant.	*Acceptable* - Fully compliant.	*Acceptable* – Expected to be fully compliant, but increased potential for CWA violations due to direct discharge to ~~Morris Run~~ municipal storm sewer.
3. *Long-Term Effectiveness and Permanence* - *Magnitude of residual risk* - *Adequacy/reliability of controls*	*Acceptable* - Fully protective (in conjunction with institutional controls and monitoring) but does not achieve RAOs of source control and aquifer restoration.	*Acceptable/Good* – Same as Alt. #1 ~~Fully protective~~ (with greater long-term assurances than Alt. #1) but does not achieve RAOs of source control and aquifer restoration.	*Good* - Better protection for Dublin Acres and Borough Well #3, and reduces potential need for upgrades to OU1 treatment system. Does not achieve RAOs of source control and aquifer restoration.	*Good/Very Good* - Better protection for Dublin Acres and Borough Well #3, and reduces potential need for upgrades to OU1 treatment system. Achieves RAO of source control but does not restore aquifer.	*Very Good* – Enhanced source control (i.e., complete hydraulic containment) in comparison to Alt #4; consequently greater degree of aquifer restoration than Alt #s 1-6. However, restoration neither complete nor permanent.
4. *Reduction of Toxicity, Mobility or Volume*	*Poor* - Only reduction in toxicity or volume is achieved via pumping of OU1 supply well and natural attenuative processes; mobility not a significant issue due to plume stability indicated by RI.	*Poor*- Only reduction in toxicity or volume is achieved via pumping of OU1 supply well and natural attenuative processes; mobility not a significant issue due to plume stability indicated by RI.	*Poor* - Only reduction in toxicity or volume is achieved via pumping of OU1 (enhanced in comparison to Alt. #s 1 & 2) and natural attenuative processes; mobility not a significant issue due to plume stability indicated by RI.	*Good* - Reduces mobility and volume (mass but not extent) of contamination through source control; however, DNAPL source and dissolved phase contamination (>MCLs) would persist for extended period of time.	*Very Good* – Complete hydraulic containment of source material significantly reduces contaminant migration.

Continued on Page 3

Table 7 Comparative Analysis of Alternatives (continued)

Criteria	Alternative No. 5 OU1 and a Downgradient Well	Alternative No. 6 OU1 and Source Area In-Situ Treatment	Alternative No. 7 OU1 (@ 20 gpm), Source Area Well @ 20 gpm, and 3 Downgradient Recovery Wells	Alternative No. 8 OU1 (@ 20 gpm), Source Area Well @ 20 gpm, and 12 Downgradient Recovery Wells
1. *Overall Protection of Human Health and the Environment*	*Acceptable* - No unacceptable risks under current conditions; institutional controls and routine monitoring provide protection in the future. Increases potential for exposure to contaminated ground water due to lateral spread of plume induced by downgradient pumping well.	*Acceptable - Same as Alt. #2* Provides no greater level of protection than other alternatives over long-term, and results in increased short term risks to site workers during implementation.	*Acceptable* – No unacceptable risks under current conditions; however concentrations approaching MCLs are predicted to reach Dublin Acres supply wells and Borough Well #3 approximately 30 years in future. Additional risk introduced by need to collect and convey contaminated ground water through portions of Borough.	*Acceptable/Good* – No unacceptable risks under current conditions and provides the most comprehensive and accelerated restoration of the aquifer; therefore, least amount of residual risk. However, additional risk introduced by need to collect and convey contaminated ground water through portions of Borough.
2. *Compliance with ARARs/TBCs*	*Acceptable* - Fully compliant.	*Acceptable* - Fully compliant.	*Acceptable/~~Poor~~* – Increased potential for CWA violations due to direct discharge to ~~Morris Run~~ municipal storm sewer and collection and conveyance of contaminated water through ~3,200 feet of pipeline.	*Acceptable ~~/Poor~~*– Increased potential for CWA violations due to direct discharge to ~~Morris Run~~ municipal storm sewer and collection and conveyance of contaminated water through ~5,300 feet of pipeline.
3. *Long-Term Effectiveness and Permanence* - *Magnitude of residual risk* - *Adequacy/reliability of controls*	*Good* - Fully protective (in conjunction with institutional controls and monitoring), but magnitude of residual risk increased due to lateral spread of plume. Does not achieve RAOs for source control and aquifer restoration.	*Good* - Fully protective and achieves reduction in magnitude of residual risk through significant reduction in contaminant source. Does not restore aquifer and does not fully achieve source control (in contrast to Alt. #4).	*Acceptable/Good* – Same as Alt # 4C but increased potential for MCL exceedances at Dublin Acres supply wells and Borough Well #3 approximately 30 years in future. Complete source control and high degree of aquifer restoration; however restoration not complete nor permanent.	*Very Good/Excellent* – Complete source control and highest degree of aquifer restoration; however, restoration not complete nor permanent.
4. *Reduction of Toxicity, Mobility, or Volume*	*Acceptable/Poor* - Increases lateral spread of plume and therefore increases volume of aquifer that is impacted.	*Good* - Reduces mobility and volume (mass but not extent) of contamination through source control; however, DNAPL source and dissolved phase contamination (>MCLs) would persist for extended period of time.	*Acceptable/Good* – Complete hydraulic containment of source material significantly reduces high strength contaminant migration. However, reduced pumping of OU1 well results in increased migration of lower levels of contamination beyond OU1 well.	*Very Good/Excellent* – Greatest reduction in migration of contamination and mass removal.

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Table 7 Comparative Analysis of Alternatives (continued)

Criteria	Alternative No. 1 No Further Action	Alternative No. 2 Limited Action	Alternative No. 3 Increased Pumping of OU1 Supply Well	Alternative No. 4 OU1 and a Source Area Well @ 5 gpm	Alternative 4C OU1 and a Source Area Well @ 20 gpm
5. *Short-Term Effectiveness* - *Time until action complete* - *Protection of community during implementation* - *Protection of workers during implementation*	*Very Good* - All remedial actions completed; no short-term risks.	*Very Good* - All remedial actions completed; no short-term risks.	*Very Good* - No additional risks; implementation/O&M period essentially the same as Alts. #1 and #2.	*Acceptable* - Higher risks to site workers during construction and O&M due to potential exposure to TCE as NAPL; extended implementation and O&M periods.	*Acceptable*~~/Poor~~ - Higher risks to site workers during construction and O&M due to potential exposure to TCE as NAPL. ~~Also potential for short-term risks to human health and ecological receptors from breaches in effluent pipeline and/or treatment system upsets.~~ Although unlikely, any breaches in integrity of ground water collection, conveyance and treatment system could result in exposures to elevated contaminant concentrations.
6. *Implementability* - *Ability to construct and operate* - *Ease of doing more if needed* - *Ability to monitor effectiveness* - *Ability to obtain approvals and coordinate with other agencies.* - *Availability of materials, services, and equipment* - *Availability of technologies*	*Very Good* - Implementation already successfully completed.	*Good* - Majority of implementation already successfully completed; additional measures easily implemented.	*Very Good* - Advantageous for Borough because only one supply well needed to meet total demand, therefore Borough's O&M costs reduced and other existing supply wells became available as backup wells.	*Good* - Would likely require pretreatment and acquisition of pretreatment permit for discharge; property access not an issue.	*Acceptable* - Extensive treatment system required to treat source area contamination sufficient for direct discharge. Effluent pipeline/outfall would require acquisition of property access and approvals from other agencies, including DRBC for ground water withdrawals >10,000 gpd and Hilltown Township for routing.
7. Cost - *Capital* - *Annual O&M** - *Total present worth*	 $0 $0 $0	 $0 $43,900/$22,000 $362,800	 $21,600 $50,400/$28,500 $465,100	 $87,900 $106,700/$84,800 $1,230,000	 $~~205,100~~105,200 $88,700/66,800 $~~1,123,800~~1,023,900
8. *State Acceptance***	---	---	---	---	---
9. *Community Acceptance***	---	---	---	---	---

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Table 7 Comparative Analysis of Alternatives (continued)

Criteria	Alternative No. 5 OU1 and a Downgradient Well	Alternative No. 6 OU1 and Source Area In-Situ Treatment	Alternative No. 7 OU1 (@ 20 gpm), Source Area Well @ 20 gpm, and 3 Downgradient Recovery Wells	Alternative No. 8 OU1 (@ 20 gpm), Source Area Well @ 20 gpm, and 12 Downgradient Recovery Wells
5. *Short-Term Effectiveness* - *Time until action complete* - *Protection of community during implementation* - *Protection of workers during implementation*	*Acceptable* - Limited, if any, short-term risks; extended implementation/O&M period.	*Acceptable* - Higher risks to site workers during implementation due to potential chemical exposures; implementation timeframe <1 yr.	*Acceptable* ~~/Poor~~ - Higher risks to site workers during construction and O&M due to potential exposure to TCE as NAPL. ~~Also, potential for short-term risks to human health and ecological receptors from breaches in effluent pipeline and/or treatment system upsets.~~ Although unlikely, any breaches in integrity of ground water collection, conveyance and treatment system could result in exposures to elevated contaminant concentrations.	*Acceptable*~~/Poor~~ – Same as Alt # 7 but even longer implementation timeframe due to number of property accesses required.
6. *Implementability* - *Ability to construct and operate* - *Ease of doing more if needed* - *Ability to monitor effectiveness* - *Ability to obtain approvals and coordinate with other agencies.* - *Availability of materials, services, and equipment* - *Availability of technologies*	*Acceptable* - Locating a well with suitable yield could be difficult, as could obtaining property access for well and conveyance pipeline. DRBC approval required for ground water withdrawals >10,000 gpd.	*Acceptable/Poor (potentially)* - Effectiveness of technology in deep fractured bedrock aquifer not well established. Requires more materials than other alternatives.	*Poor*~~/Questionable~~ - Same as Alt # 4C except for the need to obtain indefinite property access for 3 recovery wells and collection/conveyance system. DRBC approval could be more of an issue due to increased ground water withdrawal in comparison to Alt #4C.	~~*Unlikely*~~ *Poor* – Same as Alt # 7 except for the need to obtain indefinite property access for 12 recovery wells and at least 5,300 ft. of collection/conveyance system. DRBC could have more concerns ~~approval could be more of an issue~~ (in comparison to Alts #4C and 7) due to total withdrawal and volume of water unavailable for public use ~~non-beneficial use of >10x allowable limit~~.
7. *Cost* - *Capital* - *Annual O&M** - *Total present worth*	$71,000 $53,200/$30,400 $538,100	$264,800 $43,900/$22,000 $627,600	~~$1,027,900~~ $636,500 $99,100/77,200 ~~$2,075,700 NF***~~> $1,684,300***	~~$4,699,200~~ $2,807,200 $118,800/96,900 ~~$5,991,400 NF***~~> $4,099,400 ***
8. *State Acceptance***	---	---	---	---
9. *Community Acceptance***	---	---	---	---

Notes:

* Annual O&M costs reflect distinction between costs for first five years and years 6 through 30.

** To be evaluated subsequent to this FS.

~~*** NF = Not Feasible, estimated costs likely reflect lower end of a cost range – due to numerous implementability issues, the upper end of the cost range would be the conclusion that the alternative is not implementable at any cost.~~

**** In comparison to the other alternatives evaluated, the complexity of design associated with this alternative causes the estimated cost to be less accurate than the estimates for other alternatives and, in all likelihood, reflects the lower end of a cost range.

Table C-1

Estimated Costs Summary Table

Remedial Action Alternatives for Operable Unit 2

Dublin NPL Site - Dublin, Pennsylvania

Description	Initial Capital	Annual O&M (Years 1 thru 5)	Annual O&M (Years 6 thru 30)	Net Present Value (30-Year @ 7%)
Alternative 1: No Further Action	$0	$0	$0	$0
Alternative 2: Limited Action	$0	$43,900	$22,000	$362,800
Alternative 3: Increased Pumping of OU-1 Supply Well	$21,600	$50,400	$28,500	$465,100
Alternative 4: Pumping OU-1 Supply Well and a Source Area Well	$87,900	$106,700	$84,800	$1,230,000
Alternative 5: Pumping OU-1 Supply Well and a Downgradient Well	$71,100	$52,300	$30,400	$538,100
Alternative 6: Pumping OU-1 Supply Well and Source Area In-situ Treatment	$264,800	$43,900	$22,000	$627,600
Alternative 4C: Pumping OU-1 Supply Well and a Source Area Well (@ 20 gpm)	$105,200	$88,700	$66,800	$1,023,900
Alternative 7: Pumping Source Area Well (@ 20 gpm) and 3 DGWs (@ 5 gpm)	$636,500	$99,100	$77,200	$\geq$ $1,684,300*
Alternative 8: Pumping Source Area Well (@ 20 gpm) and 12 DGWs (@ 5 gpm)	$2,807,200	$118,800	$96,900	$\geq$ $4,099,400*

~~* These costs likely reflect lower end of a cost range; due to numerous implementability issues, the upper end of the cost range would be the conclusion that the alternative is not implementable at any cost.~~

* *In comparison to the other alternatives evaluated, the complexity of design associated with this alternative causes the estimated cost to be less accurate than the estimates for other alternatives and, in all likelihood, reflects the lower end of a cost range.*

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Table C-8
Alternative 7: Pumping Source Area Well (@ 20 gpm) and 3 DGWs (@ 5 gpm)
Estimated Costs Summary
Remedial Action for Operable Unit 2
Dublin NPL Site - Dublin, Pennsylvania

Cost Item	Quantity/ Unit	Unit Cost	Total Cost
Capital Costs			
Site Preparation	1 lump sum	$3,500	$3,500
Piping and Connections	1 lump sum	$8,000	$8,000
Equipment Installation/Setup	1 lump sum	$8,500	$8,500
Pre-packaged Air Stripping System	1 each	$40,000	$40,000
Manganese Sequestering System	1 each	$2,500	$2,500
Well Installation	3 each	$15,000	$45,000
Well Pumps	4 each	$2,500	$10,000
Electric to DGW Well Pumps	3 each	$5,000	$15,000
Piping to Treatment System	3,200 linear foot	$20	$64,000
Vapor Phase GAC System	1 each	$12,000	$12,000
Discharge Piping to Existing Sewer	100 linear foot	$12	$1,200
Manhole at Tie-in Location	1 each	$4,000	$4,000
Property Acquisition	4 acre	$55,000	$220,000
		Subtotal:	$433,700
		Contingency (20%):	$86,700
		Subtotal:	$520,400
		Administration & Permits (5%):	$26,000
		Legal (5%):	$26,000
		Engineering (25%):	$64,100
		Total Capital Costs:	**$636,500**
Annual O&M Costs			
Chemical Usage			
Sequestering Solution	150 gallon	$20	$3,000
Air Stripper Maintenance	1 lump sum	$1,500	$1,500
System Operator Monitoring	120 hour	$60	$7,200
VPGAC Change-out w/Disposal	3,500 pound	$3	$10,500
Equipment Replacement	1 lump sum	$3,500	$3,500
Electrical Costs	65,300 kilowatt-hour	$0.10	$6,500
Stripper Effluent Sampling	12 event	$800	$9,600
NPDES Outfall Sampling	2 event	$1,000	$2,000
		Subtotal:	$43,800
		Contingency (20%):	$8,800
		Subtotal:	$52,600
		Reporting & Administration (5%):	$2,600
		Total Annual O&M Costs:	**$55,200**

Table C-8 (continued)
Alternative 7: Pumping Source Area Well (@ 20 gpm) and 3 DGWs (@ 5 GPM)
Estimated Costs Summary
Remedial Action for Operable Unit 2
Dublin NPL Site - Dublin, Pennsylvania

Cost Item	Quantity/ Unit	Unit Cost	Total Cost
Ground Water Monitoring Costs (per event)			
Labor (2-person crew)	7 day	$1,200	$8,400
Equipment Rental, Expenses	1 lump sum	$3,860	$3,900
Laboratory Analysis	20 each	$250	$5,000
Reporting	1 lump sum	$1,000	$1,000
		Event Total:	$18,300
Years 1 through 5 (semi-annual frequency)			
Annual Sampling Event	2 each	$18,300	$36,600
		Contingency (20%):	$7,300
		Total Annual Cost (Years 1 through 5):	**$43,900**
Years 6 through 30 (annual frequency)			
Annual Sampling Event	1 each	$18,300	$18,300
		Contingency (20%):	$3,700
		Total Annual Cost (Years 6 through 30):	**$22,000**

SUMMARY OF ESTIMATED COSTS

Capital Costs:	**$636,500**
Annual O&M Costs:	**$55,200**
Annual Ground Water Monitoring Costs (Years 1 through 5):	**$43,900**
Annual Ground Water Monitoring Costs (Years 6 through 30):	**$22,000**
30-Year Net Present Value (@ 7% Discount):	**≥ $1,684,300***

Assumptions:

1. *Alternative will not involve the installation of new monitoring wells.*
2. *Existing monitoring wells (15) will be sampled semi-annually for the first 5 years and annually thereafter.*
3. *Typical monitoring well: 225 feet deep, 6-inch diameter with a depth-to-ground water of 25 feet.*
4. *Low-flow sampling protocol.*
5. *Monitoring well purge water to be discharged to the sanitary sewer system.*
6. *Downgradient well installation will require the purchase of both residential and commercial properties at fair market value.*
7. *Cost assumed for property access acquisition is half the full property purchase value, which represents the median of the likely cost range. Fair market value of residential and commercial properties reported ~~assumed~~ to be $80,000 and $140,000 per acre on average, respectively. Acreage assumed to be required is based on a conceptual pipeline routing design intended to minimize total length of pipeline and number of property accessed required.*
8. *Typical downgradient well: 450 feet deep, 30 feet of casing and 6-inch open bore.*
9. *Existing~~,~~ onsite storm sewer has the capacity to manage anticipated additional flow.*

~~* These costs likely reflect lower end of a cost range; due to numerous implementability issues, the upper end of the cost range would be the conclusion that the alternative is not implementable at any cost.~~

* *In comparison to other alternatives evaluated, the complexity of design associated with this alternative causes the estimated cost to be less accurate than the estimates for other alternatives and, in all likelihood, reflects the lower end of a cost range.*

Table C-9

Alternative 8: Pumping Source Area Well (@ 20 gpm) and 12 DGWs (@ 5 gpm)

Estimated Costs Summary

Remedial Action for Operable Unit 2

Dublin NPL Site - Dublin, Pennsylvania

Cost Item	Quantity/ Unit		Unit Cost	Total Cost
Capital Costs				
Site Preparation	1	lump sum	$3,500	$3,500
Piping and Connections	1	lump sum	$8,000	$8,000
Equipment Installation/Setup	1	lump sum	$9,500	$9,500
Pre-packaged Air Stripping System	1	each	$60,000	$60,000
Manganese Sequestering System	1	each	$3,000	$3,000
Well Installation	12	each	$15,000	$180,000
Well Pumps	13	each	$2,500	$32,500
Electric to DGW Well Pumps	12	each	$5,000	$60,000
Piping to Treatment System	12,000	linear foot	$22	$264,000
Vapor Phase GAC System	1	each	$12,000	$12,000
Discharge Piping to Existing Sewer	100	linear foot	$14	$1,400
Manhole at Tie-in Location	1	each	$4,000	$4,000
Property Acquisition	25	acre	$53,750	$1,343,800
			Subtotal:	$1,981,700
			Contingency (20%):	$396,300
			Subtotal:	$2,378,000
			Administration & Permits (5%):	$118,900
			Legal (5%):	$118,900
			Engineering (25%):	$191,400
			Total Capital Costs:	**$2,807,200**
Annual O&M Costs				
Chemical Usage				
Sequestering Solution	350	gallon	$20	$7,000
Air Stripper Maintenance	1	lump sum	$1,500	$1,500
System Operator Monitoring	120	hour	$60	$7,200
VPGAC Change-out w/Disposal	5,000	pound	$3	$15,000
Equipment Replacement	1	lump sum	$4,000	$4,000
Electrical Costs	130,600	kilowatt-hour	$0.10	$13,100
Stripper Effluent Sampling	12	event	$800	$9,600
NPDES Outfall Sampling	2	event	$1,000	$2,000
			Subtotal:	$59,400
			Contingency (20%):	$11,900
			Subtotal:	$71,300
			Reporting & Administration (5%):	$3,600
			Total Annual O&M Costs:	**$74,900**

Table C-9 (continued)

Alternative 8: Pumping Source Area Well (@ 20 gpm) and 12 DGWs (@ 5 GPM)

Estimated Costs Summary

Remedial Action for Operable Unit 2

Dublin NPL Site - Dublin, Pennsylvania

Cost Item	Quantity/ Unit	Unit Cost	Total Cost
Ground Water Monitoring Costs (per event)			
Labor (2-person crew)	7 day	$1,200	$8,400
Equipment Rental, Expenses	1 lump sum	$3,860	$3,900
Laboratory Analysis	20 each	$250	$5,000
Reporting	1 lump sum	$1,000	$1,000
		Event Total:	$18,300
Years 1 through 5 (semi-annual frequency)			
Annual Sampling Event	2 each	$18,300	$36,600
		Contingency (20%):	$7,300
		Total Annual Cost (Years 1 through 5):	**$43,900**
Years 6 through 30 (annual frequency)			
Annual Sampling Event	1 each	$18,300	$18,300
		Contingency (20%):	$3,700
		Total Annual Cost (Years 6 through 30):	**$22,000**

SUMMARY OF ESTIMATED COSTS

Capital Costs:	**$2,807,200**
Annual O&M Costs:	**$74,900**
Annual Ground Water Monitoring Costs (Years 1 through 5):	**$43,900**
Annual Ground Water Monitoring Costs (Years 6 through 30):	**$22,000**
30-Year Net Present Value (@ 7% Discount):	**≥ $4,099,400***

Assumptions:

1. *Alternative will not involve the installation of new monitoring wells.*
2. *Existing monitoring wells (15) will be sampled semi-annually for the first 5 years and annually thereafter.*
3. *Typical monitoring well: 225 feet deep, 6-inch diameter with a depth-to-ground water of 25 feet.*
4. *Low-flow sampling protocol.*
5. *Monitoring well purge water to be discharged to the sanitary sewer system.*
6. *Downgradient well installation will require the purchase of both residential and commercial properties at fair market value.*
7. *Cost assumed for property access acquisition is half the full property purchase value, which represents the median of the likely cost range. Fair market value of residential and commercial properties reported ~~assumed~~ to be $80,000 and $140,000 per acre on average, respectively. Acreage assumed to be required is based on a conceptual pipeline routing design intended to minimize total length of pipeline and number of property accessed required.*
8. *Typical downgradient well: 450 feet deep, 30 feet of casing and 6-inch open bore.*
9. *Existing, onsite storm sewer has the capacity to manage anticipated additional flow.*

~~* These costs likely reflect lower end of a cost range; due to numerous implementability issues, the upper end of the cost range would be the conclusion that the alternative is not implementable at any cost.~~

* *In comparison to other alternatives evaluated, the complexity of design associated with this alternative causes the estimated cost to be less accurate than the estimates for other alternatives and, in all likelihood, reflects the lower end of a cost range.*